

Radar Interferometry: A Review

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Radar interferometry has now progressed to a state of maturity in which it can be seriously regarded as a potential technology for spaceborne missions. In fact, it is the leading approach for a joint NASA/ASI global topographic satellite mapping mission, currently designated TOPSAT. Here we review the state of the art in radar interferometric techniques and applications.

First, we present an overview of interferometric radar theory, and then discuss operational instrument implementation. These include both airborne prototype instruments and also several spacecraft research implementations using data acquired by the NASA SEASAT radar and the ESA ERS-1 radar instruments. Topographic mapping using the JPL TOPSAR instrument currently is yielding results with an rms height accuracy of 1-2 m at 10 m spatial resolution. Data have been collected with this sensor over about 50 sites and much of the data have been released to the science community. Ongoing studies utilizing the data support work in the fields of geology and geophysics, hydrology, ecology, and ice research. Similar accuracies have been demonstrated using ERS-1 data collected over Alaska, however temporal decorrelation effects limit the usefulness of the repeat-pass satellite implementations to local or regional studies.

An extension of the technique where the interferometer baseline spans time as well as space provides sensitivity to target motion. This effect has been used in airborne sensors to map ocean waves and currents and in spaceborne to map the very much slower velocity fields associated with ice streams and glaciers. The latter has been demonstrated utilizing ERS-1 data acquired over Antarctica where the weather effects are minimal and temporal decorrelation is small.

Finally, an extension of the two pass repeat implementation that utilizes three passes to remove the effects of topography suggests that cm-level motions of the Earth's surface can be readily detected by these techniques.